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13. ABSTRACT *(Maximum 200 words)*

We summarize the research performed under grant AFOSR 87-0084. We show how the equipment provided was of great use in solving eigenvalue problems and other numerical problems. We also indicate the use of the system in the organization of NA-net. A list of some relevant papers is provided.

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Final Report on Grant **AFOSR 87–0084**

Under this grant, the following equipment was purchased:

7 SUN 3/50 workstations
1 SUN 3/260 workstation
1 SUN 3/180 file server
1 CDC disk
1 Eagle disk
2 Apple Laser Writer printers

This equipment was of utmost importance in our research in the Scientific Computing and Computational Mathematics Program at Stanford. In particular, it allowed us to analyze, devise, and study various numerical algorithms associated with our research activity. I enclose a list of recent reports which depended heavily on the use of this equipment. Here are some special activities:

The Lanczos method is a well known method for computing the eigenvalues of symmetric matrices. For many years there has been an attempt to generalize this algorithm for matrices that are non-symmetric. There have been inherent difficulties, and for a long time it was not understood how to modify the algorithm for the non-symmetric case. In the last year, it has finally been understood how to formulate a stable and robust algorithm. We were able to develop numerical software for operating on non-symmetric matrices. This software was then tested on the equipment that was bought under this grant, and finally a report was written using the SUN workstations. Several reports describing this effort are now in the process of being written.

The Lanczos algorithm has also been used as a technique for solving least squares problems with a quadratic constraint. Again, we were able to develop a numerical algorithm and perform experiments using the system, MATLAB. Indeed, the use of MATLAB has been particularly useful and has played an important role in our research efforts.

There have been many other areas that we have actively researched during this period. For instance, another important activity is the solution of partial differential equations using the multi-grid method. A large number of experiments were performed on the SUN workstations, and this influenced greatly the development of the theory. This work eventually resulted in the Ph.D. thesis of Dr. Raymond Tuminaro.

In addition to these, there are a large number of other activities that have continued. In particular, Professor Oliger and his group have been very active in studying fluid flow, weather calculations, and research in programming environments for scientific computing.

Another important use of this equipment has been for the development of NA-net. This is a computer network which allows numerical analysts throughout the world to communicate through a mail-forwarding system. This system has been developed at Stanford, and because of its ease of use and efficiency, it is used by researchers throughout the world. Another use of the numerical analysis network is to distribute a digest each week, which keeps the community aware of the latest developments in the field.

Signed,

Gene H. Golub

Recent Numerical Analysis Reports

Stanford University

Manuscript NA-89-06 May 1989
On the structure and geometry of the product SVD, by Bart De Moor.

Manuscript NA-89-07 June 1989
Iterative methods for cyclically reduced non-self-adjoint linear systems II, by Gene H. Golub and Howard Elman.

Manuscript NA-89-08 July 1989
Modified moments for indefinite weight functions, by Gene H. Golub and Martin H. Gutknecht.

Manuscript NA-89-09 August 1989
On generating polynomials which are orthogonal over several intervals, by Bernd Fischer and Gene H. Golub.

Manuscript NA-89-10 October 1989
On element-by-element preconditioning for general elliptic problems, by Han-Chow Lee and A.J. Wathen.

Manuscript NA-89-11 October 1989
Solving linear equations by extrapolation, by Walter Gander, Gene H. Golub and Dominik Gruntz.

Manuscript NA-89-12 November 1989
Backward error assertions for checking solutions to systems of linear equations, by Daniel Boley, Gene H. Golub, Samy Makar, Nirmal Saxena and Edward J. McCluskey.

Manuscript NA-90-01 February 1990
Line iterative methods for cyclically reduced discrete convection-diffusion problems, by Howard C. Elman and Gene H. Golub.

Manuscript NA-90-02 February 1990
The restricted total least squares problem: formulation, algorithm and properties, by Sabine Van Huffel and Hongyuan Zha.

Manuscript NA-90-03 March 1990
Fast training algorithms for multi-layer neural nets, by Richard P. Brent.

Manuscript NA-90-04 April 1990
Quadratically constrained least squares and quadratic problems, by Gene H. Golub and Urs Von Matt.

Manuscript NA-90-05 May 1990
Jacobi matrices for sums of weight functions, by Sylvan Elhay, Gene H. Golub and Jaroslav Kautsky.

Manuscript NA-90-06 May 1990
The nonsymmetric Lanczos algorithm and controllability, by Daniel Boley and Gene H. Golub.

Manuscript NA-90-07 June 1990
Adaptive Lanczos methods for recursive condition estimation, by William R. Ferng, Gene H. Golub and Robert J. Plemmons.

Manuscript NA-90-08 July 1990
QR-like algorithms for arrow matrices, by Peter Arbenz and Gene H. Golub.